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(54) **IMPROVED WATER JET CUTTING DEVICE**

(57) The invention relates to a water jet cutting device, comprising a cutting table (3) and a preparation table (7) which can rotate relative to a booth (4). A nozzle (1) projects water at high pressure on the workpiece (6) to be cut, which is placed on the cutting table (3). The tables (3,7) have a lower suctioning tube (10,11) that is

connected to a collecting tube (12) by means of air to retain the workpiece (6,8) on the surface of the table (3,7) or to release the workpiece from said table. A detector emits a signal indicating the position of said gates (21,22), thereby preventing rotation of the tables (3,7) if the gates (21,22) are not open.

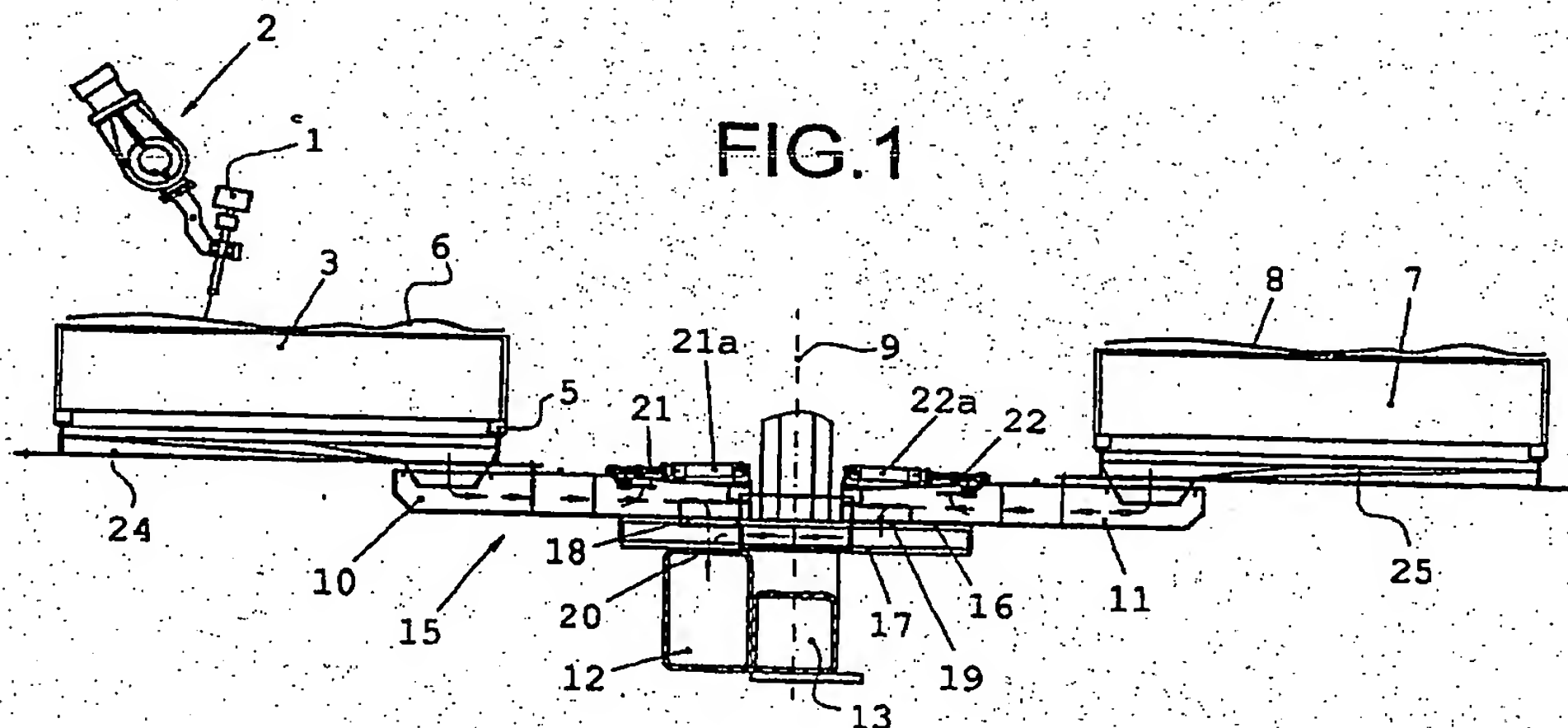


FIG. 1

Description

[0001] The present application for a patent of invention relates, as stated in its title, to an "IMPROVED WATERJET CUTTING DEVICE" which novel manufacturing, conformation and design features fulfil the purpose to which it has been specifically conceived, with a maximum safety and effectiveness.

[0002] In high pressure waterjet cutting workstocks are cut or worked by projecting a high speed water jet coming out of a nozzle. Typical materials in waterjet cutting include paper, corrugated paperboard, plastics, foam materials, sealing materials, etc.

[0003] Waterjet cutting provides many advantages: health damaging dust is not produced during cutting, there are no thermal effects on the cutting surface, the existing return forces are low, mechanical load on the materials is very reduced, there are no deformations on the material surface, cutting can be performed on any part of the material and it produces a clear cut with a burr-free finishing removing subsequent mechanizing operations on the pieces, materials are not heated up, waterjet cutting allows to cut workstocks having a thickness greater than those cut by laser with a similar finishing and it allows to cut materials that it would not be possible by using other cutting systems, as for example aluminium or glass.

[0004] In the waterjet cutting field there exist units to carry out such technique as the one disclosed in the patent of invention P9901507 which applicant is the same as the present invention. Said cutting unit comprises, among other parts, a propelling and intensifying unit provided with a pressure pump acting as a water pressure multiplying device by means of a motor controlled by integrated circuit systems adjusting all the system functions. Water is pressurized and forced to pass through a reduced diameter hole to increase output speed twice and up to three times the speed of sound that, in terms of kinetic energy, it is enough to cut a wide range of materials of a natural or synthetic origin as previously disclosed.

[0005] The unit also includes a frame inside of which there is arranged a first working or cutting table on which a projecting nozzle is acting supplying the water jet, and a second working table or processing workstock table. Provision of the two tables allow that, whilst one is working on a workstock, it is possible to process a new workstock on the other table therefore reducing down times in the cutting operation.

[0006] One of the main concerns raising in the cutting processes using this type of waterjet cutting units is the one referred to fixing and centring of the workstock on the working table. Although said operation was conventionally a manual operation, said patent provided using of a mechanical system including four conical centring members that were slightly lifted up as the working table had reached the cutting area. In that moment, the mould containing the workstock was positioned on said conical

centring members and the workstock was three-dimensionally centred.

[0007] The main object of the present invention is to provide an improved waterjet cutting unit including improved drawing means to draw the cut material that, in turn, cooperate in retaining the workstock being cut on the cutting table of the unit in position.

[0008] The improved waterjet cutting unit of the present invention basically comprises two working tables: a cutting table provided inside a cab and onto which a nozzle projects high speed water on the workstock that is arranged on said table; and a processing table disposed outside of the cab and that is suitably adapted to put thereon the piece that is to be subsequently cut. The two working tables of the unit of the present invention are allowed to rotate relative to the cab to change the positions that they are taking up, i.e. when cutting operation has finished, both tables are swapping their positions in such a way that the cutting table is away from the cab and the processing table is now inside the cab (this being now a cutting table) to start cutting a new piece.

[0009] The main feature of the unit of the present invention is that both the cutting table and the processing table are provided, at the lower part thereof, with a drawing conduit connected to a water and scale material collector conduit arranged at the lower part of the unit, that is to say, under the conduits of both tables. An air drawing main conduit, provided at an end thereof with an extractor fan, is disposed, like the water and scale material collector conduit, at the lower part of the unit in order to obtain a high drawing performance and preventing scale material from being clogged.

[0010] On the other hand, the ends of the conduit of both working tables are connected to said water and scale material collector conduit by a rotary collector.

[0011] Arrangement of the above mentioned drawing conduits, i.e. the conduit of each table and the collector conduit, at a lower position in the cutting unit cab involves a great technical advantage regarding an effective collection of cutting water and scale material produced when cutting the pieces. Said arrangement prevents cut material that usually forms a paste when mixing with cutting water (mostly soft materials or materials containing glues) from clogging the conduits, since there are no air advancement vertical sections which could complicate dragging of the scale materials.

[0012] The conduit of each table is provided with a door preferably actuated by a cylinder. Said door of each conduit has the purpose of enabling or disabling air passing so as to retain the workstock in position on the table surface or release it therefrom and, in turn, to void the pieces already cut.

[0013] According to a further aspect of the present invention, the working tables are provided with respective actuators acting on the corresponding doors of the air conduits in the tables. There is also provided a sensor outputting a signal according to the position where said

doors are in order to block rotation of both tables if the doors are not opened.

[0014] The above mentioned rotary collector connects the conduits of each table channelling the air passage to the collector conduit. Said rotary collector essentially comprises two cylindrical bodies: an upper cylindrical body and a lower cylindrical body. The upper cylindrical body is allowed to rotate relative to the lower cylindrical body and it is provided with a first opening for the air passage from the cutting table to the collector lower body and a second opening for the air passage from the processing table to said collector lower body. The lower body is provided with an opening allowing air passage to the collector conduit.

[0015] Alternatively, the rotary collector is provided with cleaning scoops radially arranged therein and serving the purpose of preventing solid material from being stuck to the walls as it is drawn into the collector conduit.

[0016] Preferably, at the end of the collector conduit there is provided a basin intended to collect the scale material and there is also provided a drawing pump to draw the cutting water.

[0017] The present invention further provides access trapdoors in the collector conduit in order to facilitate cleaning and maintenance operations.

[0018] The cutting table and the processing table of the cutting unit of the present invention are provided with respective sloped trays at the lower part thereof. Said trays allows to properly collect the water and the scale material produced during the cutting of the piece and they convey them to the respective air drawing conduit.

[0019] Further details and features of the improved waterjet cutting unit of the present invention will be apparent from the following description, which refers to the accompanying drawings that schematically represent the preferred details. These details are given by way of example, which refer to a possible case of practical embodiment, but it is not limited to the disclosed details; therefore this description must be considered from an illustrating point of view and without any type of limitations.

[0020] Fig. 1 is an elevational view that diagrammatically shows the two tables and the air drawing system;

[0021] Fig. 2 is an elevational view of an embodiment of a unit according to the present invention;

[0022] Fig. 3 is a plant view of the unit of the above figures.

[0023] A detailed list of the various parts cited in the present patent application is given below: (1) water injection nozzle, (2) robot, (3) cutting table, (4) cab, (5) centring members, (6) piece to be cut, (7) processing table, (8) piece to be processed, (9) pivot axis of the tables relative to the cab, (10) air drawing conduit of the cutting table, (11) air drawing conduit of the processing table, (12) collector conduit, (13) air drawing main conduit, (14) fan, (15) rotary collector, (16) upper cylindrical body, (17) lower cylindrical body, (18) opening for the air passage from the cutting table conduit to the upper cy-

lindrical body of the rotary collector, (19) opening for the air passage from the processing table conduit to the upper cylindrical body of the rotary collector, (20) opening for the air passage from the lower cylindrical body to the collector conduit, (21) door of the cutting table conduit, (22) door of the processing table conduit, (21a) actuating cylinder for the door of the cutting table conduit, (22a) actuating cylinder for the door of the processing table conduit, (23) washout reservoir, (24, 25) trays to collect the scale material and water from the working tables, (26) collector conduit access openings, (27) collector conduit section, (28) fan access opening, (29) fan body, (30) fan grid, (31) fan output conduit, and (32) extractor fan.

[0024] The waterjet cutting unit shown by way of a no limitative example in figs. 1, 2 and 3 is based upon high speed water jet projection through a water injection nozzle (1) fitted on a robot (2) for cutting pieces made, for example, of paperboard, plastics, foam, aluminium, etc.

[0025] The robot (2) acts on a cutting table (3) provided inside a cab (4) shown in fig. 2 of the drawings enclosed in the present specification. The cutting table (3) is arranged on centring members (5) which are fitted in such a way that they can move upwards in the frame of the unit and the piece to be cut (6) is disposed thereon.

[0026] The cutting table (3) is attached to a processing table (7) located outside the cab (4) on which the piece (8) which is to be subsequently cut by the water jet projected by the robot (2) is disposed. The cutting table (3) and the processing table (7) are rotary fitted in the frame of the cab (4) and they are allowed to rotate relative to the axis (9) shown in fig. 1. Rotation of the tables (3, 7) allows to eliminate down times in the cutting process since when cutting of the piece (6) has been finished, the other piece (8) that is being processed for the cutting thereof on the table (7), enters the cab (4), whilst the table (3) is away from the cab (4) ready to receive a new piece (8) to be processed to cut.

[0027] According to the embodiment of figures, the cutting table (3) and the processing table (7) are provided, at the lower part thereof, with respective air drawing conduits (10, 11) leading to a water and scale material collector conduit (12). Drawing of such materials is carried out by means of an air drawing main conduit (13) having, at an end thereof, an extractor fan (14). Said air drawing main conduit (13) is disposed, like the collector conduit (12), at the lower part of the unit in order to obtain a high drawing performance avoiding clogging of the scale material which usually forms a paste on mixing with cutting water. This is made possible by virtue of, as it can be seen from figures, there are no air advancement vertical sections which could complicate dragging of material. Furthermore, the fact should be stressed that the drawing sections are very short, i.e. the path the air follows from, for example, the cutting table (3) to the collector conduit (12), is very short, therefore reducing the possibility that the air flow becomes hindered by scale materials and flow thereof becomes hampered by

them through the several conduits of the unit.

[0028] Referring to fig. 1, the ends of each conduit (10, 11) of both working tables (3, 9) are connected to the collector conduit (12) by means of a rotary collector (15) comprising an upper cylindrical body (16) and a lower cylindrical body (17). The upper cylindrical body (16) is allowed to rotate relative to the lower cylindrical body (17) and it is provided with a first opening (18) for the air passage from the cutting table (3) to the lower body (17) of the collector (15), and with a second opening (19) for the air passage from the processing table (7) to the lower body (17) of the collector (15). The lower cylindrical body (17) is provided, in turn, with an opening (20) through which air passes to the collector conduit (12).

[0029] The conduits (10, 11) of each table (3, 7) are provided with doors (21, 22) actuated by cylinders (21a, 22a). The doors adjust the air passage through the conduits (10, 11). If for example the door (21) of the conduit (10) of the cutting table (3) is in the open position, air is then enabled to flow from the table (3) to the conduit (12) collecting the pieces or remnants and the water produced during cutting and, at the same time, it causes a negative pressure capable to retain the piece (6) in position preventing it from being moved during the cutting operation. Closing of the door (21) allows said piece (6) to be released from the cutting table (3). On the other hand, air flow through the conduit (11) of the processing table (7) as the door (22) is in the open position allows to hold the piece (8) that is being processed to be subsequently cut.

[0030] Coordination between the cutting operation carried out by the robot (2) and rotation of the tables (3, 7) around the axis (9) is performed by providing a sensor outputting a signal according to the position where said doors (21, 22) of the conduits (10, 11) are in such a way that rotation of both tables (3, 7) is not possible until said doors (21, 22) are opened.

[0031] Referring now to fig. 3 of the drawings, the collector conduit (12) comprises, at the end thereof, a washout comprising a reservoir (23) where scale material is collected, and there is also provided a cutting water drawing pump.

[0032] Referring again to fig. 1, the cutting table (3) and the processing table (7) are provided with respective sloped trays (24, 25) at the lower part thereof. Intended to collect the water and the scale material produced during the cutting of the piece (6) and to convey them into the collector conduit (12).

[0033] Fig. 3 shows how the upper part of said collector conduit (12) is provided with a number of openings (26) intended to gain access therein to facilitate cleaning and maintenance operations of the unit.

[0034] The drawing air flow needed for retaining the pieces to be cut (6, 8) in position and for voiding the bits of cut material is obtained from the fan (14) causing a drawing flow through section (27) of the collector conduit. A depression is produced in the access opening (28) of the fan (14) due to the air flow in the direction

shown by arrows in fig. 2 due to the conical configuration of the body (29) of the fan (14), in such a way that the air inside the body (29) of the fan (14) follows a rising swirl path passing through a grid (30) to the output conduit (31) connected to the extractor fan (32).

[0035] Once having been sufficiently described what the present patent application consists in accordance to the enclosed drawings, it is understood that any detail modification can be introduced as appropriate, provided that variations may alter the essence of the invention as summarised in the appended claims.

Claims

1. "IMPROVED WATERJET CUTTING DEVICE" comprising a cutting table (3) provided inside a cab (4) onto which a nozzle (1) projects high pressure water on a piece to be cut (6) disposed on said table (3); and a processing table (7) provided outside said cab (4) adapted to receive thereon the piece (8) that it is to be subsequently cut, said tables (3, 7) being allowed to rotate relative to said cab (4) to change the positions they are taking up, **characterized in that** each table (3, 7) is provided, at the lower part thereof, with an air drawing conduit (10, 11) connected to a water and scale material collector conduit (12) fitted under said conduits (11, 12), said conduits (11, 12) of the respective tables (3, 7) being connected to said collector conduit (12) by a rotary collector (15) connecting the output thereof.
2. "IMPROVED WATERJET CUTTING DEVICE" according to claim 1, **characterized in that** said rotary collector (15) comprises an upper cylindrical body (16) and a lower cylindrical body (17), said upper cylindrical body (16) being provided with a first opening (18) for the air passage from the cutting table (3) to the lower body (17) of the collector (15) and a second opening (19) for the air passage from the processing table (7) to said lower body (17) of the collector (15); and said lower body (17) being provided with an opening (20) allowing air passage to the collector conduit (12).
3. "IMPROVED WATERJET CUTTING DEVICE" according to claim 2, **characterized in that** the rotary collector (15) is provided with cleaning scoops serving the purpose of preventing solid material from being stuck to the inner walls thereof.
4. "IMPROVED WATERJET CUTTING DEVICE" according to claim 1, **characterized in that** the conduit (10, 11) of each table (3, 7) is provided with respective doors (21, 22) actuated by cylinders (21a, 22a) having the purpose of enabling or disabling air passing so as to retain the piece (6, 8) in position on the surface of the table (3, 7) or release it there-

from.

5. "IMPROVED WATERJET CUTTING DEVICE" according to claim 4, **characterized in that** there is provided a sensor outputting a signal according to the position where said doors (21, 22) are in order to block rotation of both tables (3, 7) if the doors (21, 22) are not opened.
6. "IMPROVED WATERJET CUTTING DEVICE" according to claim 1, **characterized in that** the end of the collector conduit (12) is provided with a wash-out comprising a reservoir (23) where scale material is collected, and a cutting water drawing pump.
7. "IMPROVED WATERJET CUTTING DEVICE" according to claim 1, **characterized in that** the collector conduit (12) is provided with access openings (26) for cleaning and maintenance operations.
8. "IMPROVED WATERJET CUTTING DEVICE" according to claim 1, **characterized in that** the cutting table (3) and the processing table (7) are provided with respective sloped trays (24, 25) at the lower part thereof to collect the water and the scale material produced during the cutting of the piece (6) conveying them to the collector conduit (12).

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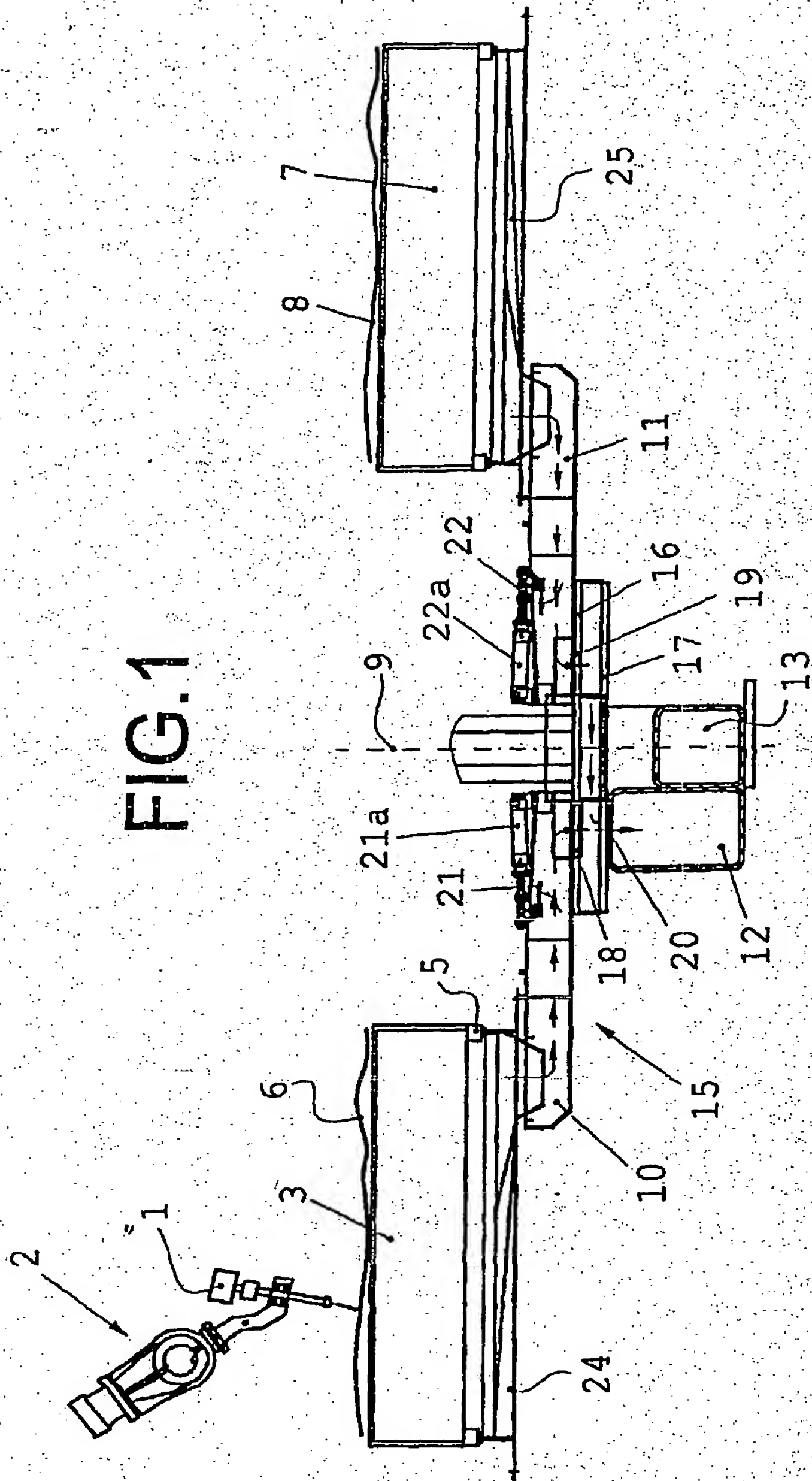


FIG.1

FIG.2

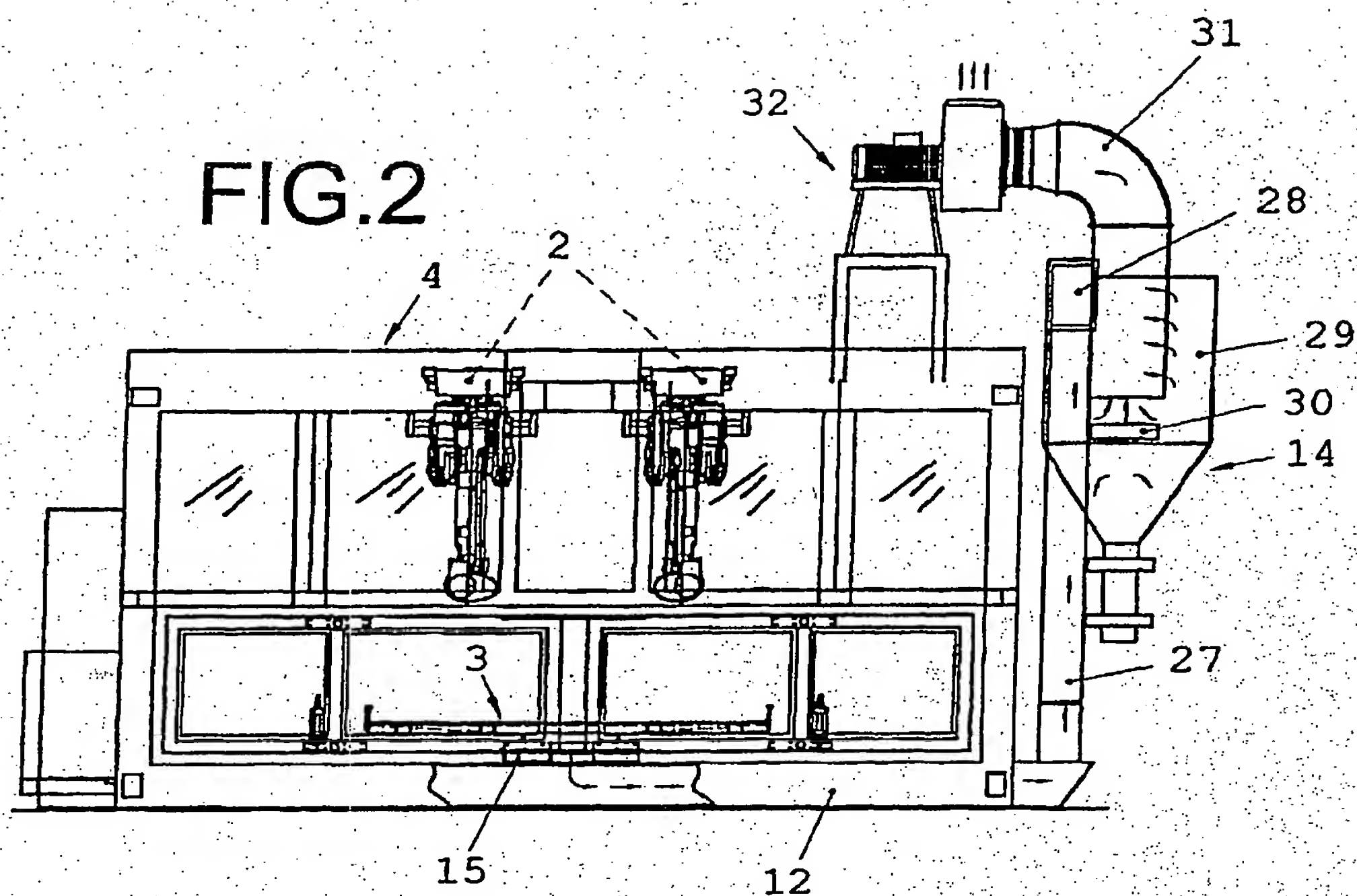
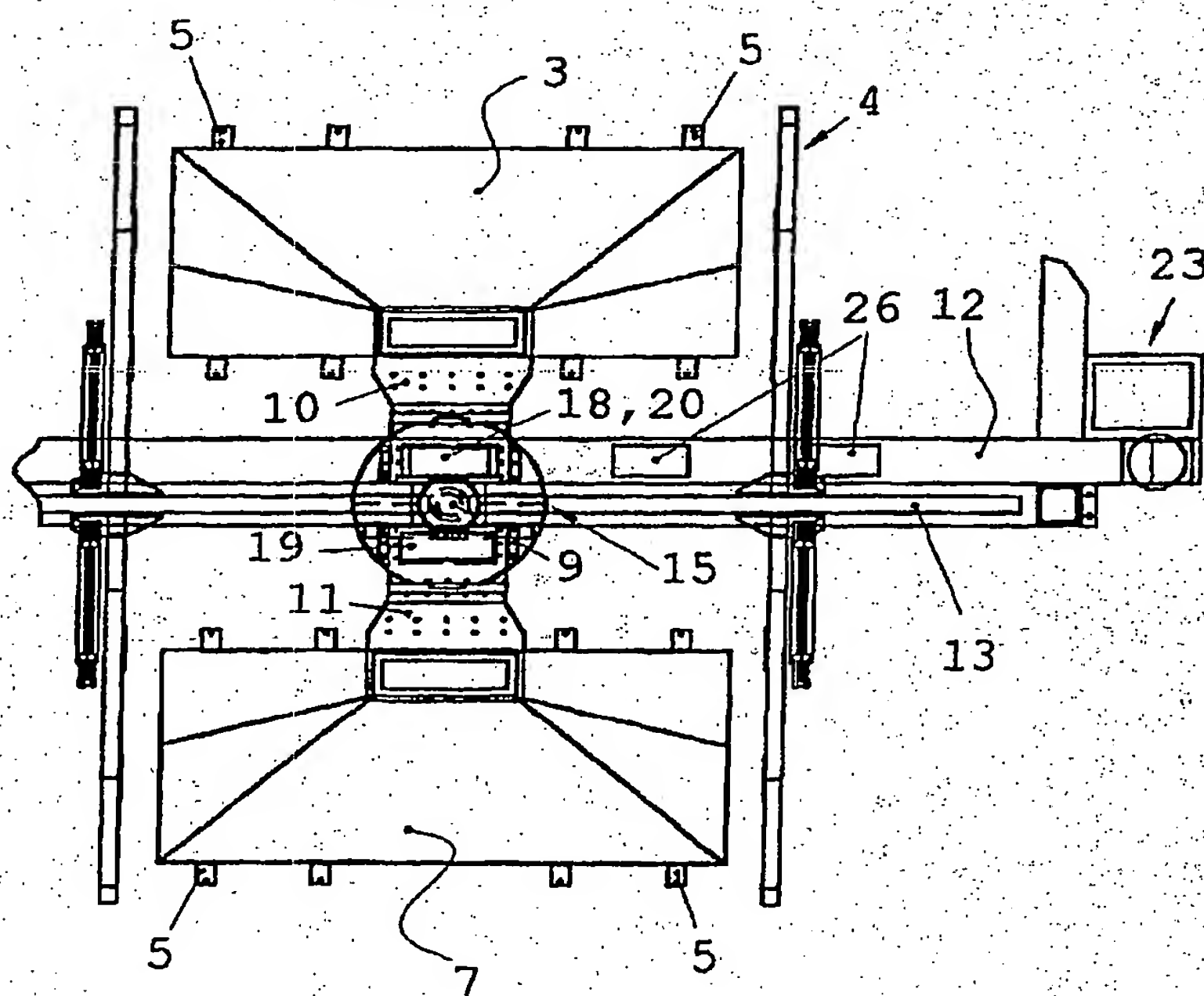


FIG.3



INTERNATIONAL SEARCH REPORT

International application No.

PCT/ES 01/00140

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B26F 3/00, B26D 7/01

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B26F 3

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 8813449 U (Herbert Olbrich GmbH & Co. KG); 1 March 1990 (01.03.90), figures 1,2	1
A	ES 8609168 A (Libbey Owens Ford Co.); 16 December 1986 (16.12.86), the abstract, figures 1,2	1
A	DE 4217157 A (Heckler & Koch GmbH); 25 November 1993 (25.11.93), the abstract, figures	1
A	US 4686877 A (Jaritz et al.); 18 August 1987 (18.08.87), the abstract, figures	1

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search	Date of mailing of the international search report
13 June 2001 (13.06.01)	2 July 2001 (02.07.01)
Name and mailing address of the ISA/ S.P.T.O.	Authorized officer
Facsimile No.	Telephone No.

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INTERNATIONAL SEARCH REPORT
 Information on patent family members

International Application No

PCT/ES 01/00140

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 8813449 U	01.03.1990	NONE	
DE 4217157	25.11.1993	NONE	
US 4686877	18.08.1987	AT 114985 EP 207050 CA 1261733	15.10.1987 30.12.1986 26.09.1989
ES 8609168	16.12.1986	ES 8609167 ES 8609166 IT 1182879 IT 1182878 IT 1182877 US 4711056 US 4702042 US 4656791 GB 2165174 GB 2164880 GB 2164879 FR 2570638 FR 2570637 FR 2570636 SE 8504454 SE 8504453 SE 8504452 LU 86087 LU 86086 LU 86085 DE 3533342 DE 3533341 DE 3533340 CA 1253789 CA 1252711 CA 1248009 BR 8504671 BR 8504670 BR 8504669 BE 903279 BE 903278 BE 903277 AU 4704685 AU 4704585 AU 4704285 JP 61091027 JP61091026 JP61091028	16.12.1986 16.12.1986 05.10.1987 05.10.1987 05.10.1987 08.12.1987 27.10.1987 14.04.1987 09.04.1987 03.04.1986 03.04.1986 28.03.1986 28.03.1986 28.03.1986 28.03.1986 28.03.1986 11.03.1986 11.03.1986 11.03.1986 24.04.1986 03.04.1986 17.04.1986 09.05.1989 18.04.1989 03.01.1989 15.07.1986 15.07.1986 15.07.1986 16.01.1986 16.01.1986 16.01.1986 10.04.1986 10.04.1986 10.04.1986 09.05.1986 09.05.1986 09.05.1986